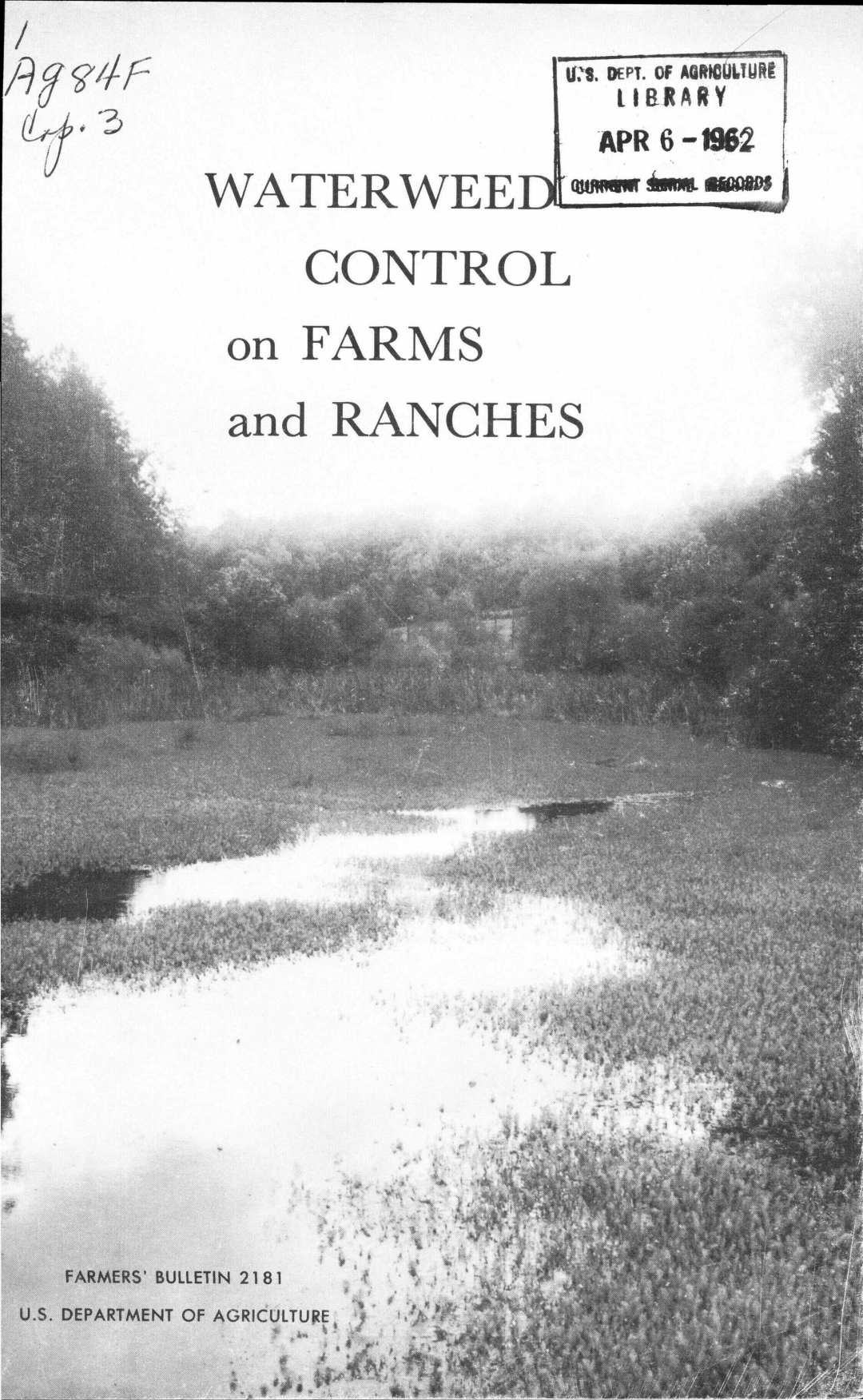
WATERWEED CONTROL on FARMS and RANCHES



FARMERS' BULLETIN 2181

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WATERWEED CONTROL on FARMS and RANCHES

By Verne E. Davison, John M. Lawrence, and Lawrence V. Compton [1]

Waterweed Problems

Waterweeds present serious problems in agricultural water whether you impound it for irrigation, livestock, fish, wild ducks, or for other purposes. At least 100 kinds of troublesome waterweeds grow in the South, and no section of the United States is free of them. You can expect some kind of waterweeds or troublesome water plants to invade most impoundments unless you manage the water and the plants to prevent or control them.

Deepening pond edges and filling in marshy spots help prevent waterweeds from getting started. Fertilization of the water, moderate grazing around the pond, and the use of ducks and certain algae-eating fish will control weeds after they get started. Also, there are chemical poisons for use in killing weeds but these provide only temporary control because the weeds will return unless conditions are made unfavorable for their growth.

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GA—D22-5

Waterweeds interfere with efficient use of farm and ranch ponds.

GA–D22–4

Farm ponds that are free of waterweeds are easier to use for livestock watering, irrigation, fishing, and other agricultural purposes.

Waterweeds in Fishponds

If you want a good farm or ranch fishpond, you must manage it to prevent and control waterweeds, whether they grow beneath the surface of the water, on the surface, or around the pond edge. Weeds interfere with fishing and make fertilization impractical. They protect mosquito larvae from small fish and protect the small fish from the big fish which should eat them.

Prevention and control of waterweeds begin with the construction—even the design—of ponds. For weedless ponds deepening the edges sharply to a depth of 2 to 3 feet and diking off the shallow water at the inlet will help prevent waterweed problems. Experienced soil conservationists can help you with the site selection, design, and construction of your pond.

The repeated use of chemical herbicides is expensive and often reduces fish production. Therefore the emphasis is on weed prevention rather than on control by chemicals or mechanical methods.

Muddy waters do not grow weeds and they produce little food for fish. On the other hand, a weedless, muddy pond may suddenly fill with weeds when erosion is stopped on its watershed.

To understand the care you give a high-yielding fishpond, see USDA Farmers' Bulletin 2094, Managing Farm Fishponds for Bass and Bluegills.

Waterweeds in Irrigation Reservoirs

Waterweeds often grow in waters stored for irrigation. They clog outlet and inlet pipes, spray nozzles, and irrigation structures. They also harbor mosquitoes and interfere with fishing.

Many irrigation reservoirs are shallow, have flat bottoms, and are subject to frequent drawdown and refilling. Neither deep edges nor fertilization controls weeds in such impoundments because of the fluctuating water levels and the water change. Disking or plowing while the pond bottom or edges are dry helps control cattails and similar marsh plants.

In deeper reservoirs, or those in which drawdowns are infrequent, fertilization and deep edges may be practical.

Water that has been treated with dalapon, 2,4-D, 2,4,5-T, or silvex should not be used for spraying or irrigating sensitive crops until it has been tested for safety. (See p. 15 for test method.)

Sodium arsenite is another chemical dangerous to irrigated crops. Manufacturers' instructions usually caution you to allow 3 to 4 days after treatment with sodium arsenite before using the water on crops. In large irrigation reservoirs, you may wish to kill only the submersed weeds near the outlet. In such cases, use the sodium arsenite 10 days to 2 weeks before pumping from the reservoir to allow complete decomposition of the dead vegetation.

FLA–D39–4

Waterweeds reduce and sometimes stop the flow of water in irrigation and drainage ditches.

FLA–D23–2

Water flows easily in ditches with weed-free channels.

Waterweeds in Ditches

Waterweeds in the channels of irrigation and drainage ditches can reduce and sometimes stop the flow of water.

Grazing helps prevent growth of waterweeds along the sides. Both grazing and mowing can be used where the side slopes are gentle. Unfortunately gentle side slopes usually are not practical except for small farm ditches.

Several chemical herbicides are helpful in the control of waterweeds in irrigation and drainage ditches.

Types of Waterweeds

To control waterweeds (including grasses) you need not know every kind by name.[2] The way they grow separates most of them into six groups: (1) Submersed waterweeds, (2) marsh plants, (3) rooted plants with floating leaves, (4) floating plants, (5) algae, and (6) shrubs and trees. Control of these plants by planned fertilization and chemicals is covered in separate sections. Prevention and other control measures are covered here.

Submersed Waterweeds

Submersed waterweeds are those that grow chiefly below the surface of the water though their flowers and a few leaves may extend

[2] See list of Common Waterweeds and Their Control, p. 19.

above it. They usually are rooted to the bottom. Hornwort (coontail), bladderwort, elodea, naiad, and the potamogetons are examples of plants in this group.

To prevent submersed waterweeds in ponds, shade them out with murky water. Fertilization of the water causes microscopic algae to grow and usually shades out all the weeds in water over 18 inches deep, but the pond edges must be 2 to 3 feet deep for good results.

Marsh Plants

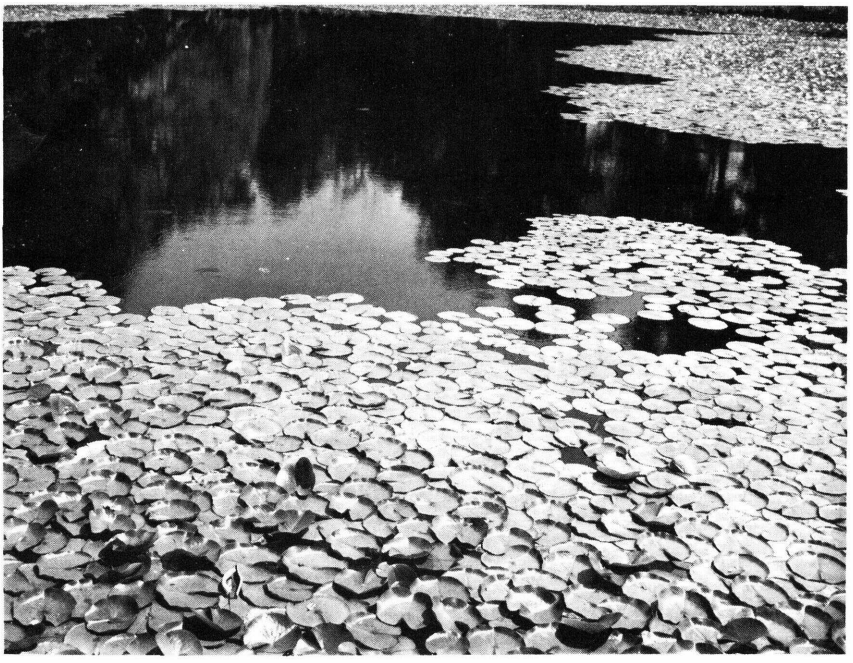
Marsh plants grow along pond edges, drainage ditches, and canals and in shallow water. They include pennywort, rushes, cattails, sedges, grasses, and even shrubs.

You can prevent marsh plants in ponds or confine them to a narrow band by deepening the pond edge to a depth of 2 to 3 feet—preferably 3 feet. At the same time, fill in any marshy edges around your pond. Also, clear the trees and brush back 20 feet or more from the water's edge. Then establish a low-growing grass sod right up to the edge.

Grazing livestock is the easiest way to control grasses, shrubs, trees, and vines around your pond. But overgrazing exposes the soil to erosion and your livestock may muddy the pond seriously by wading. If this happens, fence them out. Grazing reduces the usefulness of pond areas to upland wildlife by reducing the amount of food and

MINN–1674

Cattails are typical of waterweeds that grow along pond edges.



GA–D8–162

Waterlilies have floating leaves but their roots are in the pond bottom.

cover. (In the North and West most pond owners fence their ponds to exclude livestock.)

Deep edges and grazing help control cattails. Some other control measures are:

Pulling as new ones appear—Pull cattails before they colonize with extended root growth. Even well-established beds can be pulled with surprising ease. Start by pulling the plants farthest out in the pond and work toward the shore.

Cutting—Cut cattails with a scythe close to the ground and under the water when possible. Cut them during the 10 days in early summer when the flowering heads are only a half to two-thirds formed. A follow-up cutting a month later usually finishes the job. They may require a third cutting.

Draining water and plowing the ground—When cattails become established on extensive areas of level wet lands—marshes, shallow duckponds, or large irrigation reservoirs—drain the water off and plow the ground.

Flooding—Constant flooding to a depth of 3 feet will usually kill cattails.

Spraying—For large areas where none of the above measures are feasible, spray cattails with dalapon.

Rooted Plants With Floating Leaves

Waterlilies and watershield are examples of rooted plants with leaves that float on the water surface. To prevent plants in this group, (1) deepen the edges, (2) fertilize to make the water murky

and thus prevent germination and growth from seeds, and (3) don't plant them.

You can kill small patches of waterlilies and watershield by frequent cutting of the leaves. You may need to make five or six cuttings a year. Continue until leaves appear no longer.

Unless you fertilize enough to color the water, these plants will return; or, as often happens, even more troublesome ones such as naiad, elodea, and hornwort come in. You should not, therefore, try to kill the waterlilies and watershield unless you can color the water by high fertility.

Floating Plants

Floating plants include water-hyacinth, the tiny duckweeds (*Lemna*, *Wolffia*), and waterlettuce (*Pistia*). These plants float on the pond surface. Their roots feed from the water rather than from the soil.

Duckweeds cover a pond when (1) trees, brush, or high banks prevent wind from reaching the pond surface; (2) submersed weeds such as the naiads and potamogetons grow to the surface and hold the little floating plants in place; or (3) floating logs and trash prevent wind action.

To prevent duckweeds, allow the wind to blow them freely to the pond edges. Cut brush and trees where necessary to open the pond surface to the wind.

By keeping 6 or 8 tame ducks per acre of pond surface, you can prevent duckweeds from coming in and control them if they are already in your pond.

You can remove duckweeds by seining them from the surface if weeds, logs, or brush do not interfere.

LA–61832

Water-hyacinth usually floats freely but sometimes it is rooted in mud.

Algae

Filamentous algae, or pond scum, are plants that grow as a mass of slender hairlike fibers (filaments). They grow on the bottom of ponds, on logs, or at the surface—usually anywhere there is a bit of organic matter. They interfere with fishing and help mosquito production. There are two commonly troublesome types — single-filament and branched-filament algae.

To prevent single-filament algae, keep weeds, grass stems, hay, leaves, manure, and other organic matter out of the pond.

The common fresh-water variety of the branched-filament algae is *Pithophora*. You can recognize it by its cluster-like growth, the branching of its filaments, and the coarse texture of the strands. It feels and looks much like a mass of discolored wet cotton. Sodium arsenite kills *Pithophora* but the need for repeated applications makes this treatment less than satisfactory. Use of Israeli carp, which eat filamentous algae, now appears practical. Fifty 5-inch or larger fingerlings per surface acre is the correct stocking for carp. Under these conditions, Israeli carp will not muddy the water and they will not spawn successfully.

Similarly, mullet and tilapia are known to control successfully *Cladophora*, a branched algae that is troublesome in brackish widgeongrass duckponds. The correct stocking rate for these brackish water species has not been determined.

For assistance in using algae-feeding fish to control filamentous algae, see your soil conservationist.

The hairlike spikerushes (*Eleocharis baldwinii* and *E. acicularis*) are marsh-edge plants which sometimes form floating masses. Don't confuse them with filamentous algae.

Shrubs and Trees

Shrubs and trees are troublesome around ponds. Willows, alders, buttonbush, briars, and woody vines are controlled by deepening the

GA–D17–39

Filamentous algae, or pond scum, grows as a mass of hairlike fibers on the bottom of ponds or at the surface.

GA—D24—4

The tiny duckweed is free-floating and is blown across the water by the wind. Tame Muscovy ducks will keep it under control.

pond edges, by grazing, and by mowing when necessary. Willows may be pulled easily until they begin their second-year growth.

Waterweed Control by Fertilization

In the Southeast, fertilization (as needed) is a profitable way to control waterweeds in a pond. Besides darkening the water, it increases fish food. This results in greater fishing success and higher yields.

Highly fertile water grows millions of microscopic algae. These plants shade the pond bottom and prevent the seeds of waterweeds from germinating and growing. (Muddy water shades out waterweeds but does not grow fish food. Natural acid or organic coloration in certain "black-water ponds" also shades the bottom against weeds.)

Several kinds of these microscopic plants will be present naturally in every pond. They grow in fertile water when water temperatures are moderate or warm—usually early spring through summer and into mid-fall. In Florida, southern California, and the southern parts of the Southwestern States, South Carolina, Georgia, and the Gulf States, they grow in winter too. In the northern parts of these States the growing season starts in February. Through the central part of the United States from Maryland to North Carolina and westward from Nebraska to Oklahoma, it is usually warm enough to begin fertilization by March or early April.

NC–D13–26

Carefully regulated grazing helps control weeds on shores and banks.

You should build up the dark color quickly and as early as you can—to prevent growth of submersed weeds. And you should maintain the dark color during the growing season of the waterweeds by continued fertilization. Don't let seedlings sprout and grow. If you already have a heavy growth of waterweeds, you cannot color the water by fertilizing. The leafy waterweeds take up the fertilizer and the water remains clear. In such cases you can either kill the weeds with chemicals or shade them out with winter fertilization. As soon as you kill the weeds, begin fertilizing to darken the water.

Fertilizer will not control submersed weeds in irrigation and drainage ditches, or temporary irrigation reservoirs. Nor will fertilizer control submersed weeds in ponds and lakes that have large flows of water. If the volume of water entering a pond in a month exceeds the volume in the pond, the flow is too great for successful fertilization. Diversion of part of the water around the pond may be feasible. A double-sleeve trickle tube or similar device to take overflow from the bottom of a pond will make fertilization successful in a pond with a moderate flow of water. Your Soil Conservation Service technician can help you where too much flow is the problem.

Not much is known about the success of fertilization for waterweed control in colder northern waters or in alkaline waters of the West. But there has been enough success to warrant your trying it if you live in this area. If fertilization fails, you may have to depend on chemical herbicides for weed control.

Kind of Fertilizer

Use mineral fertilizers—not organic. Organic fertilizers, such as cottonseed meal, blood meal, manure, hay, and leaves, encourage filamentous algae, sometimes called "pond scum."

A satisfactory analysis is 8 pounds of nitrogen (N), 8 pounds of phosphorus (P), and 2 pounds of potash (K) per 100 pounds of fertilizer. This is known in the trade as 8–8–2. You may use a stronger fertilizer such as 10–10–5, 12–12–6, 16–16–4, 20–20–5, or similar analyses. Just be sure it has as much nitrogen as phosphorus. More exacting fertilizers probably could be developed for different waters (western alkaline waters for example) but an 8–8–2 or near equivalent is satisfactory for most of the waters east of the Great Plains.

How Much Fertilizer

No one can predict exactly how much fertilizer your pond will require. It may require as much as 1,500 pounds per surface acre each year, though the average acre of water will have adequate weed control with 800 to 1,200 pounds annually. You will need to apply from 100 to 200 pounds of 8–8–2 or its equivalent per acre at each application. Your pond will need fewer applications in dry years and more when heavy rains dilute the fertile water.

Ordinarily, the water will be clear at winter's end. Then you will need to make several applications at 10-day intervals until the color test shows that the fertility is built up—that sunlight can no longer reach the bottom to grow waterweeds. Examine the pond every week or two to tell when to add fertilizer again. In the warmer climates, the color can be maintained all year by fertilizing as needed.

You can make a simple testing device by nailing a white disk to the end of a stick. Hold it 12 to 14 inches below the water. If you can see the white disk, your pond needs more fertilizer.

How to Apply Fertilizer

Pour fertilizer into the water in a thin stream from a boat; broadcast it by hand from the bank of small ponds; or place it on stationary or floating platforms that are 6 to 12 inches below the pond surface (one platform will suffice for 15 acres). You need not scatter the fertilizer evenly all over the pond. Wind and wave action will distribute it. Avoid placing the fertilizer in water deeper than 5 feet. When pouring fertilizer from a boat, a single line on each side of the pond is sufficient.

Winter Fertilization

You can kill submersed weeds by applying fertilizer on the weed beds in winter. This method takes 4 to 5 months, but it is the safest and most profitable way to kill them. Begin fertilizing in December in Florida and in January or early February a little farther north. Use fertilizer of the same analysis as you apply at other times for weed control (8–8–2 or similar). But broadcast the fertilizer from a boat over the weed beds, applying about 200 pounds per surface acre. Repeat every 2 weeks until a heavy growth of single-filament algae covers the weeds.

TENN–D29–1

A floating platform is a practical way of fertilizing pond water for weed control.

The weeds, thus totally shaded, die in early summer. The whole mass then floats to the top, remains a few days, and then sinks to the bottom where it quickly disintegrates.

Your pond water will turn green immediately after the weeds disappear. Until then, the water will remain clear as it always does when growing weeds are present.

Caution: **Winter fertilization is not successful if a large amount of water flows through the pond. If, in winter or spring, the total flow in a month exceeds the volume of water stored, you cannot economically keep enough fertilizer in the pond.**

Chemicals To Kill Waterweeds

Many chemicals are now available for the control of waterweeds. When used carefully at rates recommended they seldom cause any great loss of fish. The chemicals most practical for control of weeds in or near agricultural waters are discussed in the following sections.

Sodium Arsenite

Sodium arsenite will kill almost any plant, but it is recognized as a severe treatment because it will also kill people, livestock, and wildlife. It kills filamentous algae, waterlettuce, and the tiny duckweeds, but it does not kill water-hyacinths. Sodium arsenite is only effective in impounded waters; it is not effective in canals or streams.

Sodium arsenite is sold in liquid form as Atlas A, Penite-8, and Triox.[3] Use 3 gallons of Atlas A, 1½ gallons of Penite-8, or 2 gallons of Triox per acre-foot of average pond water. This is a concentration of about 4 p.p.m. In soft (acid) waters, one-half this amount usually makes a satisfactory kill. Hard water (alkaline) may require double that amount.

Fill an ordinary garden sprinkler can half full with liquid arsenite and the rest with water; stir and then sprinkle the contents over the weed beds.

If your pond is more than half filled with weeds, treat only one-third to one-half of it at a time, waiting a week between each application. This will avoid killing fish by oxygen deficiency caused by the decay of a large mass of dead weeds.

After submersed weeds have been destroyed, their return must be avoided by keeping the pond water in a murky condition. This can be done effectively and economically only with adequate applications of fertilizer. Begin fertilization within 10 days after treatment with sodium arsenite. Repeat applications at 2-week intervals until the microscopic algae hides a white object from sight when held 12 inches beneath the surface.

Caution: **Sodium arsenite is a dangerous caustic poison. Animals like its salty taste. It doesn't take much of it to kill a pet, a wild or domestic animal, or a person. Follow the cautions stated by the manufacturer. Better still, employ someone who has experience in the use of this chemical. Sodium arsenite kills fish if it is used in concentrations stronger than double the above recommendations. Even as recommended, it will kill some but not all of the insect nymphs and larva which are foods of pondfish.**

Keep children and animals away from the chemical, the empty drums, and the spray equipment. Avoid skin contact with the liquid or spray; in case of skin contact, wash off immediately. Wash contaminated clothing with hot, soapy water before reuse. If you get a skin rash from contact with spray, bathe, apply milk of magnesia to affected skin, and allow to dry on. Apply milk of magnesia before going to bed at night and again in the morning for 2 to 3 days or until rash clears up. If rash continues, see a doctor.

If any of the chemical is accidentally swallowed, induce vomiting by giving a tablespoonful of salt in a glass of warm water and repeat until vomit fluid is clear. Then give 2 tablespoons of epsom salts or milk of magnesia in water followed by several glasses of milk or water. Have victim lie down and keep quiet. Call a physician immediately.

Goggles should be worn while spraying. If any sodium arsenite is splashed in the eyes, flush eyes out thoroughly with water and bathe with boric-acid solution or boric-acid eyewash. See a doctor.

Don't use sodium arsenite in waters that soon afterward will be used for irrigation. Don't use sodium arsenite-treated water for

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[3] Trade names are used in this publication solely to provide specific information. Mention of a trade name does not constitute a guarantee or warranty of the product named and does not signify that this product is recommended to the exclusion of other comparable products.

bathing, for watering lawns or animals, or for any other purpose for 2 weeks following treatment.

Keep livestock away from the treated pond until a heavy rain has washed away any sodium arsenite that may have drifted onto the bank or shore plants. Although domestic animals would probably not drink enough of the treated water to be injured, it is almost impossible to treat a pond thoroughly and not leave some of the poison on the shore plants. Stock may be attracted by the salty taste and eat enough of the treated plants to be poisoned.

Since rice plants are extremely sensitive to arsenic, do not use it in waters intended for rice culture.

Residual effects of sodium arsenite may remain in the bottom soil a long time. Repeated applications reduce fish production. Therefore, you should kill the weeds once if necessary, then keep the water fertilized throughout the growing season to prevent regrowth of the pond weeds.

2,4-D

2,4-D kills many kinds of broad-leaved plants but does not kill grass. Its principal use around agricultural waters is to kill brush, waterweeds, and marsh plants such as small willows, water-hyacinths, waterhemp, waterprimrose, lotus, pickerelweed, and similar plants with leaves that rise above the water surface. When 2,4-D is used in diesel oil or in crankcase oil, the mixture also restricts the growth of most grasses and sedges. 2,4-D does not harm fish, wildlife, or livestock and is not a fire hazard.

Three forms of 2,4-D are commonly available—esters, amine salts, and sodium salts (occasionally ammonium salts). The esters and amine salts of 2,4-D are usually sold as a liquid and the sodium salt as a powder. 2,4-D is also available in granular form.

To kill most waterweeds, marsh plants, grasses, sedges, and shrubs around ponds, mix 1 cup (8 ounces) of 40- or 50-percent esters of 2,4-D in 5 gallons of diesel oil or used crankcase oil. The oil has weed-killing properties and helps the 2,4-D to penetrate the plant leaves and stems.

The amount of spray needed varies with the rankness of plant growth and the type of spraying equipment. You may use any type of equipment that will give uniform coverage. You must wet the plants from top to bottom. With pressures of 25 to 35 pounds and low-volume nozzles, you can spray an acre with only 20 to 50 gallons. As much as 80 pounds of pressure may be used, but high pressures result in more vapor with consequent drift. For heavy cattail growths you may have to use as much as 200 gallons of spray per acre.

A single spraying seldom kills all the plants. You can spray again after 2 or 3 weeks if needed. Spray on sunny days at least 3 hours before sundown—preferably earlier. Do not spray when plants are wet with dew or rain or when you expect rain within 3 or 4 hours after spraying.

To kill water-hyacinths, mix 1 quart of amine salts of 2,4-D (4 pounds active ingredient per gallon) in 100 gallons of water (the addition of a wetting agent such as household detergent will increase the effectiveness of the mixture). Use 50 to 100 gallons of spray to

an acre of hyacinths. One application should kill 90 percent or more of the plants. Follow up with a second spraying in 2 to 3 weeks and repeat until the last hyacinth is dead. It will take 2 to 6 applications. Or you may prefer to remove the last few by hand.

To kill submersed weeds and rooted plants with floating leaves. A granular form of 2,4-D, containing 20 percent active ingredient, is effective on several pond weeds such as cowlily, waterlilies, watershield, parrotfeather, waterprimrose, hornwort, and bladderwort at rates of 100 to 150 pounds of granules per acre. This form of 2,4-D has not yet been thoroughly tested on all types of submersed weeds.

Granules of 2,4-D may be applied on submersed weeds in the fall and winter. Such treatments after July seldom affect the plants until the following spring when those sensitive to this chemical usually fail to appear.

In treating parrotfeather, or other waterweeds, the first application may miss a clump here and there. If so, place a second application on and around the area of plants that are recovering.

***Caution:* Fish kills have followed a few treatments with 2,4-D granules, but the exact cause is not known.**

Tobacco, cotton, clovers, tomatoes, and many other valuable broad-leaved plants are extremely sensitive to 2,4-D sprays. Small amounts of spray vapor drift surprising distances from the area being treated and kill or damage sensitive plants. Because of this danger, spray only when there is little wind movement. Never store, 2,4-D near fertilizers, seeds, or insecticides. Always keep container closed tightly.

Water treated with 2,4-D or 2,4,5-T should not be used for spraying or irrigating sensitive crops until tested. You can test it by spraying the water on young tomato plants. If the stems do not bend within 24 hours, the water is safe.

Since it is practically impossible to wash 2,4-D out of the spraying equipment, do not use this equipment for insecticides or fungicides.

Excessive amounts of diesel oil sprayed on pond waters give an unpleasant flavor to fish for about 4 weeks after the spraying.

2,4-D deteriorates in time. Use fresh-dated material.

2,4,5–T

2,4,5-T is especially suited for killing woody plants such as brambles, vines, and shrubs that are not killed easily with 2,4-D. 2,4,5-T does not harm fish, livestock, or wildlife. It is not flammable and will not corrode equipment. Use 1 cup (8 ounces) of 2,4,5-T in 5 gallons of diesel oil.

A spray of one-half cup (4 ounces) each of an ester form of 2,4–D and 2,4,5-T in 5 gallons of diesel oil is suitable for the edges of ponds where both herbaceous and woody plants grow. Plants must be wet from top to bottom.

Silvex

Silvex is a phenoxy compound related to 2,4-D and 2,4,5-T and is effective on spatterdock cowlily, waterlilies, frogbit, parrotfeather, bladderwort, spikerush, and other waterweeds. Silvex may be

sprayed on emergent leaves or sprinkled into pond water. When sprinkled into the water, the rate is 3 or 4 parts per million. One manufacturer's product contains 1 pound of silvex per quart; thus 8 to 11 quarts of this product per acre-foot of pond water equals 3 or 4 p.p.m. Three pints per acre-foot (about 0.5 p.p.m.) has been effective on white waterlilies, watershield, and cowlily.

Silvex appears to be the best chemical to control spikerush (especially *Eleocharis acicularis* and *E. baldwinii*) in pond waters. This plant grows along the shore as water recedes, then rapidly develops floating mats in the pond. Dalapon is used to control spikerush on the shore.

As a spray on emergent plants, 3 or 4 quarts of commercial silvex (totaling 3 or 4 pounds chemical ingredient) per acre is satisfactory. One quart of silvex in 5 to 10 gallons of water is effective for low-growing plants—10 to 20 gallons for taller ones.

Silvex is not poisonous to livestock at the rates recommended by its manufacturers.

Caution: **Silvex may give fish an unfavorable taste for several days after application.**

Dalapon

Dalapon kills grasses and grasslike plants such as maidencane, cattails, cutgrass, mannagrass, and knotgrass but not broad-leaved plants. It is a powder to be mixed in water for spraying. Silvex, 2,4-D, or 2,4,5-T may be added to a dalapon solution when both grasses and broad-leaved plants are to be killed. Mix the dalapon first, using not more than 8 pounds to each 10 gallons of water. Addition of a wetting agent, such as household detergent, increases the effectiveness of the mixture.

Manufacturers recommend different rates for different conditions. Usually for noncrop areas such as those around ponds, mix 1 pound of dalapon with 1 gallon of water and use 15 to 30 pounds per acre at each application. If necessary to get "coverage" of rank growth, 2 gallons of water may be used per pound. As with other sprays, wet the foliage thoroughly. A second or third application may be necessary.

Dalapon is not effective on marsh plants in water more than 6 inches deep because of dilution of the chemical. Lower the water level before treating with dalapon.

Caution: **Do not allow spray or spray drift to contact foliage or roots of lawn grass or similar blade-leaved plants that are to be left unharmed.**

Dalapon causes skin irritation. Avoid contact with skin, eyes, and clothing. Wear rubber boots. In case of contact, remove clothing and wash skin with plenty of soap and water. For eyes, flush with water for at least 15 minutes and get medical attention. Wash clothing before reuse.

Flush spraying equipment immediately after use with plenty of water to avoid contaminating later sprays and possible corroding of equipment.

Irrigation water should not be contaminated with dalapon.

Ammate (Ammonium Sulfamate)

Ammate kills poison ivy, honeysuckle, persimmon, sassafras, wild cherry, and most kinds of trees and shrubs. It is a yellowish crystalline material that is very soluble in water. It is not combustible and is not poisonous to humans, livestock, wildlife, or fish. It is not volatile and is therefore safe to use near cotton, tomatoes, ornamental shrubs, or other broad-leaved plants that are sensitive to 2,4-D.

For shrubs or trees under 2 inches in diameter, spray the green leaves in late spring. A kill will be more likely if you spray the stems and trunk also. One pound of ammate in 1 gallon of water is the correct mixture for spraying. Addition of a wetting agent, such as household detergent, increases the effectiveness of the mixture.

For trees 2 to 6 inches in diameter, cut off the tree close to the ground, leaving a V-shaped notch in the stump. Apply 1 tablespoon of ammate crystals to kill the stump or moisten it thoroughly with a strong solution of ammate (4 to 6 pounds per gallon of water).

For larger trees, cut deep gashes every 4 to 6 inches around the trunk at the base of the tree. Put 1 tablespoon of crystals in each cut or saturate it with the solution of ammate (4 to 6 pounds per gallon).

Caution: **Ammate causes iron to rust unless such equipment is washed thoroughly after using. Prepare the solution in a glass or earthen jar or a wooden bucket. Since the solution irritates the skin, avoid prolonged contact with it. Wash the hands and face frequently with water.**

Copper Sulfate

Copper sulfate, as a weed-control chemical, is used chiefly to control microscopic algae and the single-filament algae. It also kills stonewort (*Chara*). It is not effective against leafy waterweeds, either submersed or emergent. It is sold in powder, crystal, or liquid form. Copper sulfate is known also as "bluestone," and "blue vitreol."

Three pounds of powder or crystals per acre-foot of water (about 1 p.p.m.) is strong enough to kill algae and stonewort in most waters. This concentration kills snails but does not kill fish. In alkaline water stronger concentrations may be necessary. A little experimenting will help you decide the right amount for your pond.

The crystals may be scattered by hand on the surface of small ponds or tied in a loosely woven bag and swished through the water behind a boat. Or the crystals or powder can be dissolved in water and sprinkled or sprayed on. The powder dissolves much more rapidly than the crystals and therefore is easier to mix as a spray.

In the recommended concentrations, copper sulfate may be used without harm in waters for livestock or irrigation.

If a heavy growth of algae is present, treat only one-third or one-half of the pond at a time at weekly intervals. This is to avoid depleting the oxygen when the mass of dead organic matter decomposes. You may treat an isolated mass of stonewort or algae without treating the whole pond.

In very soft water (less than 20 p.p.m. hardness) use only 1½ pounds of copper sulfate per acre-foot, as fish may be killed at the 3-pound rate. (Fish have been killed, however, in coastal pond waters having a high pH, when the smaller amount was used.)

Plastic garden sprinkling cans are convenient for applying copper sulfate. It corrodes galvanized cans and most spraying equipment. Even after normal washing they are often ruined.

Caution: **Residual copper is toxic to many aquatic animals so that frequent and continued use kills a large part of the fish-food supply. Therefore, it is unwise to use copper sulfate regularly in fishponds.**

Since copper sulfate kills algae, it should not be used when you are fertilizing to control weeds.

Aromatic Solvents

Aromatic solvents are derived from petroleum or coal tar and are commonly used as paint thinners. Certain of the aromatic solvents will control submersed waterweeds in irrigation and drainage ditches. They kill the stems and leaves but do not kill the roots and seeds. Thus the control is temporary. Aromatic solvents also kill fish, snails, crayfish, and mosquito larvae.

Aromatic solvents give economical weed control in ditches with flows of 1 to 70 cubic feet per second. In larger ditches, mechanical weed removal is usually less costly. Consult persons who are experienced and have the proper equipment for weed control in ditches.

Several chemical companies are marketing ready-to-use mixtures of aromatic solvents with suitable emulsifiers. These mixtures are applied through spray nozzles below the water surface at a pressure of 50 pounds or more per square inch. In western alkaline waters, a concentration of 740 p.p.m. applied for 30 minutes gives adequate control of submersed weeds for most of a season. This is 10 gallons of aromatic solvent applied for each cubic foot per second of flow in the canal.

In southeastern soft waters, applications of only 80 p.p.m. (about 1 gallon of solvent for each cubic foot per second of flow) is sufficient for a first cleanout, followed by maintenance applications of only 20 p.p.m. at intervals of 6 to 9 months.

Treated water is distasteful but not harmful to cattle.

Caution: **Use a respirator to avoid excessive breathing of the fumes which cause severe headaches and asthma. Wash the hands and face thoroughly with soap and water. Prolonged or frequent contact with the skin causes burning and irritation.**

Aromatic solvents are as flammable as gasoline and must be handled with equal care. Treated water should not be used for irrigating crops until the emulsion clears—27 to 72 hours after treatment.

These solvents are toxic to fish.

Common Waterweeds and Their Control

Common and scientific name	Type of waterweed	How to prevent	How to control
Algae, filamentous, branched, *Pithophora.*	Algae	Unknown	Algae-eating fish.
Algae, filamentous, single-filament	Algae	Avoid organic matter	Copper sulfate; algae-eating fish.
Algae, microscopic	Algae	Do not fertilize	Copper sulfate.
Alder, *Alnus* spp	Tree	Sod [1]	Ammate; 2,4,5-T.[2]
Alligator weed, *Alternanthera philoxeroides.*	Marsh plant	Uncertain	Graze.[3]
Arrow-arum, *Peltandra virginica*	Marsh plant	Deepen [4]	2,4-D.[2]
Arrowhead, *Sagittaria* spp	Marsh plant	Deepen;[4] sod [1]	2,4-D.[2]
Beakrush, *Rynchospora* spp	Marsh plant	Deepen;[4] graze [3]	2,4-D.[2]
Beggarticks, *Bidens* spp	Marsh plant	Deepen;[4] sod [1]	2,4-D.[2]
Bladderwort, *Utricularia* spp	Submersed waterweed	Shade [5]	Winter fertilization; 2,4-D granules; silvex; sodium arsenite.
Bulrush, *Scirpus* spp	Marsh plant	Deepen [4]	2,4-D.[2]
Burreed, *Sparganium* spp	Marsh plant	Deepen;[4] sod [1]	2,4-D;[2] silvex.
Buttercup, *Ranunculus* spp	Marsh plant	Deepen [4]	2,4-D;[2] 2,4-D granules.
Buttonbush, *Cephalanthus occidentalis.*	Shrub	Sod;[1] pull	Ammate; silvex; 2,4,5-T.[2]
Cattail, *Typha* spp	Marsh plant	Deepen;[4] graze [3]	Pull; cut; plow; dalapon; 2,4-D.[2]
Chara, see stonewort.			
Coontail, see hornwort.			
Cordgrass, *Spartina* spp	Marsh plant	Graze;[3] deepen [4]	Flood; dalapon.
Cowlily, *Nuphar advena*	Rooted plant with floating leaves.	Deepen;[4] shade [5]	Silvex; 2,4-D granules.
Cutgrass, *Leersia* spp	Marsh plant	Graze [3]	2,4-D;[2] dalapon; graze or flood deeply.
Duckpotato, see arrowhead.			
Duckweeds, *Lemna, Wolffia, Spirodela.*	Floating plant	Expose to wind [6]	Ducks; 2,4-D;[2] sodium arsenite.
Eelgrass, *Zostera marina*	Submersed plant	Shade [5]	Uncertain.
Elodea, *Elodea* spp	Submersed plant	Shade [5]	Winter fertilization; silvex; 2,4-D granules; sodium arsenite.

See footnotes at end of table.

Common Waterweeds and Their Control—Continued

Common and scientific name	Type of waterweed	How to prevent	How to control
Fanwort, *Cabomba* spp	Submersed plant	Shade [5]	Winter fertilization; 2,4-D granules; silvex; sodium arsenite.
Floatingheart, *Nymphoides* spp	Rooted plant with floating leaves.	Shade [5]	Silvex; 2,4-D;[2] cut.
Frogbit, *Limnobium spongia*	Marsh plant	Deepen [4]	2,4-D;[2] silvex.
Giantcutgrass, *Zizaniopsis milacea*	Marsh plant	Graze [3]	Graze or flood deeply; dalapon.
Grasses, *Gramineae*	Marsh plant	Graze [3]	Dalapon; 2,4-D.[2]
Horned pondweed, see poolmat.			
Hornwort, *Ceratophyllum demersum*	Submersed waterweed	Shade [5]	Winter fertilization; 2,4-D granules; sodium arsenite.
Horsetail, *Equisetum* spp	Marsh plant	Deepen [4]	2,4-D.[2]
Hyacinth, water, see water-hyacinth.			
Lizards-tail, *Saururus cernuus*	Marsh plant	Deepen [4]	Silvex.
Lotus, American, *Nelumbo lutea*	Rooted plant with floating leaves.	Deepen;[4] shade [5]	2,4-D.[2]
Ludwigia, *Ludwigia* spp	Marsh plant	Deepen [4]	Silvex.
Maidencane, *Panicum hemitomon*	Marsh plant	Deepen;[4] shade;[5] graze [3]	Dalapon.
Mannagrass, *Glyceria* spp	Marsh plant	Graze [3]	Dalapon; 2,4-D.[2]
Marestail, *Hippuris vulgaris*	Marsh plant	Deepen;[4] shade [5]	Sodium arsenite.
Mermaidweed, *Prosperinaca* spp	Submersed waterweed	Deepen;[4] shade [5]	Silvex; sodium arsenite.
Mudplantain, *Heteranthera* spp	Marsh plant	Deepen [4]	2,4-D;[2] sodium arsenite.
Muskgrass, see stonewort.			
Naiad, *Najas* spp	Submersed waterweed	Shade [5]	Winter fertilization; silvex; sodium arsenite.
Parrotfeather, *Myriophyllum* spp	Submersed waterweed	Shade [5]	2,4-D granules; silvex.
Pennywort, *Hydrocotyle* spp	Marsh plant	Deepen [4]	2,4-D;[2] silvex.
Pickerelweed, *Pontederia cordata*	Submersed waterweed	Deepen [4]	Silvex; 2,4-D.[2]
Pond scum, see algae, filamentous.			
Pondweed, see potamogeton and poolmat.			
Poolmat, *Zannichellia palustris*	Submersed waterweed	Shade [5]	Winter fertilization; sodium arsenite.
Potamogeton, *Potamogeton* spp	Submersed waterweed	Shade [5]	Winter fertilization; 2,4-D granules; silvex; sodium arsenite.

Reed, common, *Phragmites communis.*	Marsh plant	Deepen;[4] graze [3]	Flood deeply; dalapon.
Rush, *Juncus* spp	Marsh plant	Deepen [4]	Silvex; 2,4–D;[2] flood.
Sawgrass, *Cladium jamaicensis*	Marsh plant	Deepen [4] or dry out	Uncertain.
Sedge, *Carex* spp	Marsh plant	Deepen [4]	2,4–D;[2] dalapon; silvex.
Smartweed, *Polygonum* spp	Marsh plant	Deepen;[4] cut	2,4–D;[2] silvex.
Spatterdock, see cowlily.			
Spikerush, *Eleocharis acicularis* and *E. baldwinii.*	Marsh plant	Deepen;[4] maintain water level.	Silvex in the pond; dalapon on the edge.
Stonewort, *Chara* spp	Submersed waterweed	Shade [5]	Copper sulfate; sodium arsenite.
Sweetflag, *Acorus calamus*	Marsh plant	Deepen [4]	2,4–D.[2]
Tear-thumb, *Polygonum* spp	Marsh plant	Deepen [4]	2,4–D.[2]
Three-cornered grass, see bulrush.			
Waterchestnut, *Trapa natans*	Floating plant	Do not plant	2,4–D.[2]
Waterfern, *Azolla caroliniana* and *Salvinia rotundifolia.*	Floating plant	Uncertain	2,4–D.[2]
Watergrass, Carolina, *Hydrochloa carolinensis.*	Submersed waterweed	Deepen;[4] graze [3]	2,4–D;[2] winter fertilization; sodium arsenite.[7]
Waterhemlock, *Cicuta* spp	Marsh plant	Deepen [4]	2,4–D.[2]
Waterhemp, *Acnida* spp	Marsh plant	Deepen [4]	2,4–D.[2]
Water-hyacinth, *Eichhornia crassipes.*	Floating plant	Do not plant	2,4–D amine salts in water.
Waterhyssop, *Bacopa* spp	Marsh plant	Deepen [4]	2,4–D;[2] silvex.
Waterlettuce, *Pistia stratiotes*	Floating plant	Do not plant	Sodium arsenite.
Waterlily, *Nymphaea* spp	Rooted plant with floating leaves.	Shade;[5] do not plant	2,4–D granules; silvex; cut.
Watermilfoil, see parrotfeather.			
Waterplantain, *Alisma* spp	Marsh plant	Deepen [4]	Silvex.
Waterprimrose, *Jussiaea* spp	Marsh plant	Deepen [4]	2,4–D;[2] 2,4–D granules; silvex.
Waterstarwort, *Callitriche* spp	Submersed waterweed	Uncertain	Sodium arsenite.
Waterstargrass, see mudplantain.			
Watershield, *Brasenia schreberi*	Rooted plant with floating leaves.	Shade [5]	2,4–D granules; silvex; sodium arsenite; cut.
Waterweed, see elodea.			
Waterwillow, *Decodon verticillatus*	Marsh plant	Deepen [4]	2,4–D;[2] silvex.
Widgeongrass, *Ruppia maritima*	Marsh plant	Fresh water	Sodium arsenite.
Willow, *Salix* spp	Tree	Graze;[3] pull	2,4,5–T;[2] 2,4–D;[2] silvex; ammate.

[1] Establish good grass sod around the pond.
[2] Esters of 2,4–D and 2,4,5–T are mixed in diesel oil or used crankcase oil.
[3] Graze with livestock or mow frequently.
[4] Deepen edges and fill to eliminate marshy condition.
[5] Shade the bottom against sunlight by fertilizing.
[6] Wind action needed. Destroy submersed weeds or logs if either is present.
[7] Sodium arsenite poured heavily on *clumps* of Carolina watergrass usually kills it.

IN BRIEF

Preventing waterweeds:

- On *marshy edges*, deepen the edges and fill them in.
- In *open water*, fertilize enough to shade out sunlight and keep organic matter to a minimum.
- For *duckweeds*, allow for wind action on the water surface or keep ducks on the pond.

Controlling waterweeds:

- On *areas around ponds*, graze or mow grasses, shrubs, and vines.
- In *brackish widgeongrass duckponds*, keep mullet in the pond to control branched-filament algae.
- In *fresh-water ponds*, keep Israeli carp in the pond to control branched-filament algae.
- For *single-filament algae*, use copper sulfate or place algae-eating fish in the pond.
- For *edge and marsh plants*, use a spray of esters of 2,4-D in diesel oil. (Dalapon or 2,4-D may be used on *cattails*.)
- For troublesome *shrubs and trees around ponds*, use ammate, 2,4-D, 2,4,5-T, or silvex.
- For most *submersed weeds* in ponds and *submersed weeds and duckweeds growing together*, use sodium arsenite, silvex or 2,4-D granules.
- For *submersed weeds* in southern and mid-United States latitudes, apply fertilizer on the weed beds in winter.
- For *submersed weeds* in irrigation and drainage ditches use aromatic solvents (with emulsifiers).
- For *waterlilies* and *watershield*, use silvex or 2,4-D granules.
- For *water-hyacinths*, spray frequently with amine salts of 2,4-D mixed with water.
- For *waterlettuce*, spray with sodium arsenite.

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